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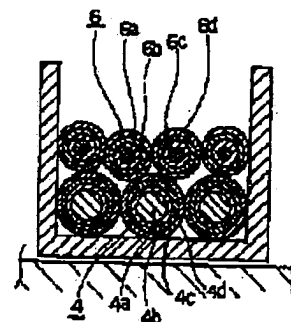
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## (54) MULTI-LAYER INSULATING ELECTRIC WIRE AND TRANSFORMER USING THE SAME

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a multi-layer insulating electric wire having an insulating layer with high heat resistance, high soldering capability, and a transformer formed by winding the insulating electric wire, with high electric characteristics and high reliability.

SOLUTION: A multi-layer insulating electric wire has a conductor 6a and two or more extrusion insulating layers 6b-6d capable of soldering, covering the conductor 6a, at least one layer of the insulating layers 6b-6d is formed with a resin mixture of 100 pts.wt. at least one resin (A) selected from polyether imide resin and polyether sulfone resin and 10 pts.wt. or more at least one resin (B) selected from polycarbonate resin, polyarylate resin, polyester resin, and polyamide resin.



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CLAIMS

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## [Claim(s)]

[Claim 1] It is the multilayer insulated wire which comes to have the extrusion insulating layer in which soldering more than two-layer [ which covers a conductor and said conductor ] is possible. As opposed to at least one sort of (Resin A) 100 weight sections as which at least one layer of said insulating layer was chosen from polyetherimide resin and polyether sulphone resin Multilayer insulated wire characterized by being formed from the resin admixture which blended at least one sort of resin (B) chosen from polycarbonate resin, polyarylate resin, polyester resin, and polyamide resin more than 10 weight sections.

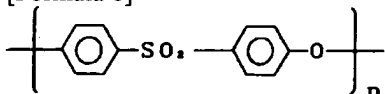
[Claim 2] Multilayer insulated wire according to claim 1 characterized by said resin (A) being polyether sulphone resin.

[Claim 3] Multilayer insulated wire according to claim 1 characterized by said resin (B) being polycarbonate resin.

[Claim 4] Multilayer insulated wire according to claim 1 characterized by for said resin (A) being polyether sulphone resin, and said resin (B) being polycarbonate resin.

[Claim 5] Multilayer insulated wire according to claim 1, 2, 3, or 4 characterized by said resin (A) being polyether sulphone resin which comes to have the repeating unit expressed with the following type.

## [Formula 1]



(n shows a positive integer among a formula.)

[Claim 6] Multilayer insulated wire of any one publication of claim 1-5 with which said resin admixture is characterized by carrying out 10-70 weight section combination of the resin (B) to the (Resin A) 100 weight section.

[Claim 7] Multilayer insulated wire of any one publication of claim 1-6 characterized by coming to cover said insulating layer on this without heating a conductor beforehand to the temperature which does not exceed 140 degrees C or carrying out a preheating.

[Claim 8] Multilayer insulated wire of any one publication of claim 1-7 characterized by forming insulating layers other than at least one layer formed of the aforementioned resin admixture with thermoplastic polyester resin or polyamide resin in said insulating layer.

[Claim 9] Multilayer insulated wire of any one publication of claim 1-8 characterized by the maximum upper layer of said insulating layer consisting of polyamide resin.

[Claim 10] The transformer characterized by coming to use the multilayer insulated wire of any one publication of said claim 1-9.

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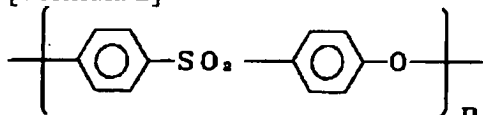
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## MEANS

[Means for Solving the Problem] The above-mentioned technical problem of this invention was attained by the transformer which used the following multilayer insulated wire and this. It is the multilayer insulated wire which comes to have the extrusion insulating layer in which soldering more than two-layer [ which covers a conductor and said conductor ] is possible. namely, this invention -- (1) -- As opposed to at least one sort of (Resin A) 100 weight sections as which at least one layer of said insulating layer was chosen from polyetherimide resin and polyether sulphone resin The multilayer insulated wire characterized by being formed from the resin admixture which blended at least one sort of resin (B) chosen from polycarbonate resin, polyarylate resin, polyester resin, and polyamide resin more than 10 weight sections, (2) Multilayer insulated wire given in (1) term characterized by said resin (A) being polyether sulphone resin, (3) Multilayer insulated wire given in (1) term characterized by said resin (B) being polycarbonate resin, (4) Multilayer insulated wire given in (1) term characterized by for said resin (A) being polyether sulphone resin, and said resin (B) being polycarbonate resin, (5) The multilayer insulated wire of (1), (2), (3), or (4) term publication characterized by said resin (A) being polyether sulphone resin which comes to have the repeating unit expressed with the following type, [0009]

[Formula 2]



[0010] (n shows a positive integer among a formula.)

(6) The multilayer insulated wire of any one publication of the (1) - (5) term with which said resin admixture is characterized by carrying out 10-70 weight section combination of the resin (B) to the (Resin A) 100 weight section, (7) Without heating a conductor beforehand to the temperature which does not exceed 140 degrees C or carrying out a preheating In said insulating layer the multilayer insulated wire of any one publication of the (1) - (6) term characterized by besides coming to cover said insulating layer, and (8) -- The multilayer insulated wire of any one publication of the (1) - (7) term characterized by forming insulating layers other than at least one layer formed of the aforementioned resin admixture with thermoplastic polyester resin or polyamide resin, (9) The transformer characterized by coming to use the multilayer insulated wire of any one publication of the (1) - (8) term characterized by the maximum upper layer of said insulating layer consisting of polyamide resin and the multilayer insulated wire of any one publication of the (10) aforementioned (1) - (9) term is offered.

[0011]

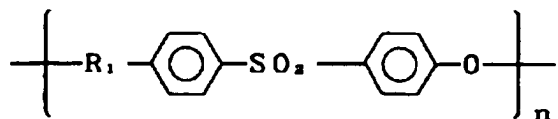
[Embodiment of the Invention] In the multilayer insulated wire of this invention, an insulating layer consists of more than two-layer, and consists of three layers preferably. The number of them is at least one, and when thinking thermal resistance as important, as for the insulating layer which consists of the aforementioned resin (A) and admixture of (B) among this insulating layer, it is desirable that all layers consist of this admixture. Moreover, it is desirable to form the maximum upper layer of an insulating

layer in a lubricative good resin layer, when thinking coil workability as important, and to use the other layer as the layer which consists of this resin (A) and admixture of (B). Said resin (A) is resin with high thermal resistance, and it can use polyether sulphone resin as this resin, choosing it from a well-known thing. What this polyether sulphone resin is expressed with the following general formula (1) to is used preferably.

[0012]

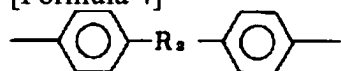
[Formula 3]

一般式 (1)



[0013] The inside of [type and R1 are single bond or -R2-O- (R2 is a phenylene group, a BIFENIRIREN radical, and [0014])

[Formula 4]



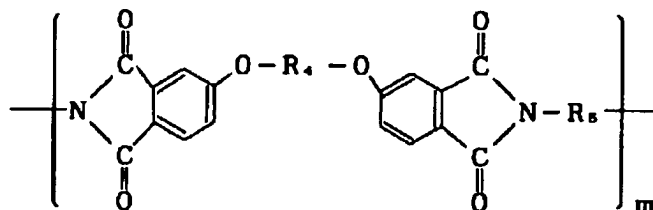
[0015] It is (R3 shows alkylene groups, such as -C(CH3)2- and -CH2-), and is R2. The radical may have the substituent further. It is shown. n shows a positive integer.]

[0016] The manufacture approach of this resin itself is well-known, and the method of reacting and manufacturing dichloro diphenylsulfone, Bisphenol S, and potassium carbonate in a high-boiling point solvent, as an example, is raised. As commercial resin, there are Leh Dell A, Victrex PES (Sumitomo Chemical Co., Ltd. make, trade name) and Leh Dell R-UDEL (the product made from Amoco, trade name), etc. Moreover, polyetherimide resin can be used as said resin (A). This polyetherimide resin is also well-known with the manufacture approach, as an example, it carries out solution polycondensation, using 2 and 2' - screw [3-(3, 4-dicarboxy phenoxy)-phenyl] pro pansy acid-anhydride, 4, 4'-diamino diphenylmethane as a solvent, and orthochromatic-dichlorobenzene is compounded in it. This polyetherimide resin is preferably expressed with a general formula (2).

[0017]

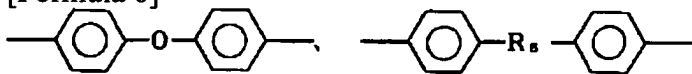
[Formula 5]

一般式 (2)



[0018] The inside of [type, R4, and R5 are the phenylene group which may have the substituent, a BIFENIRIREN radical, and [0019].

[Formula 6]



[0020] (R6 is the alkylene group of carbon numbers 1-7 preferably among a formula, and they are methylene, ethylene, and a propylene (especially preferably isopropylidene) preferably) Or a naphthylene radical is shown and alkyl groups (methyl, ethyl, etc.) etc. are raised as a substituent in case these radicals have a substituent. m is a positive integer.] As commercial resin, there is ULTEM (GE

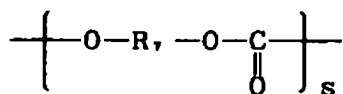
plastics company make, trade name) etc.

[0021] As for a resin constituent, soldering nature is given by mixing heat-resistant resin (A) and resin (B) in this invention. The aforementioned polycarbonate resin and polyarylate resin which are used as this resin (B), polyester resin, and especially polyamide resin are not limited. What is manufactured by the approach well-known as a raw material in dihydric alcohol, a phosgene, etc. can be used for polycarbonate resin. As commercial resin, there are Lexan (GE plastics company make, trade name), a pan light (Teijin formation shrine make, a trade name), a you pyrone (the Mitsubishi Gas Chemical Co., Inc. make, trade name), etc. A well-known thing can be used for the polycarbonate resin used for this invention. For example, there are some which are expressed with a general formula (3).

[0022]

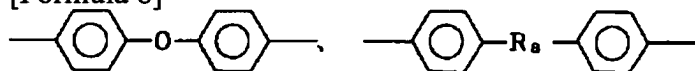
[Formula 7]

一般式 (3)



[0023] The inside of [type and R7 are the phenylene group which may have the substituent, a BIFENIRIREN radical, and [0024].

[Formula 8]



[0025] (R8 is the alkylene group of carbon numbers 1-7 preferably among a formula, and they are methylene, ethylene, and a propylene (especially preferably isopropylidene) preferably) Or a naphthylene radical is shown and alkyl groups (methyl, ethyl, etc.) etc. are raised as a substituent in case these radicals have a substituent. s is a positive integer.]

Moreover, polyarylate resin is manufactured by interfacial polymerization, and bisphenol A dissolved in the alkali water solution, and the call / iso mixing phthalic-acid chloride dissolved in organic solvents, such as halogenated hydrocarbon, are made to react in ordinary temperature, and it compounds it. There is a U polymer (the Unitika, Ltd. make, trade name) etc. as commercial resin. Moreover, what is manufactured by the approach well-known as a raw material in dihydric alcohol, divalent aromatic carboxylic acid, etc. can be used for polyester resin. As commercial resin, polyethylene terephthalate (PET) system resin is a BAIRO pet (the Toyobo Co., Ltd. make, trade name), a bell pet (the Kanebo, Ltd. make, trade name), and Teijin PET (the Teijin, Ltd. make, trade name). As for polyethylenenaphthalate (PEN) system resin, Teijin PEN (the Teijin, Ltd. make, trade name) and polycyclohexane-dimethylene-terephthalate (PCT) system resin have EKUTA (the Toray Industries, Inc. make, trade name) etc.

[0026] Furthermore, what is manufactured by the approach well-known as a raw material in diamine, dicarboxylic acid, etc. can be used for polyamide resin. As commercial resin, nylon 6 and 6 have Amilan (the Toray Industries, Inc. make, trade name), Zytel (the Du Pont make, trade name), and Mara Neal (the Unitika, Ltd. make, trade name), and, as for Unitika Nylon 46 (the Unitika, Ltd. make, trade name), nylon 6, and T, nylon 4 and 6 has Arlen (Mitsui petrochemical company make, trade name) etc.

[0027] Moreover, it is presumed that resin (B), such as polycarbonate resin blended with the resin (A) which has thermal resistance in this invention, polyarylate resin, polyester resin, and polyamide resin, generates components which some resin decomposes at the time of kneading with this heat-resistant resin (A) and soldering as an insulated wire, and show a flux operation at it, such as carboxylic acids, amines, alcohols, and aldehydes. In this invention, the loadings of the resin (B) to the (Resin A) 100 weight section are more than 10 weight sections. Resin 100 (A) To the weight section, although resin (B) of thermal resistance is expensive in under 10 weight sections, soldering nature is not obtained. Although the upper limit of the loadings of resin (B) is defined in consideration of the heat-resistant

level to demand, it is below the 100 weight sections preferably. In maintaining high soldering nature and realizing heat-resistant high level especially, as for the amount of the resin (B) used, it is desirable to carry out to below 70 weight sections, and the range in which the balance of both this property is especially good, and suitable serves as resin (B) 20 - 50 weight sections. Soldering nature can improve the soldering nature of itself especially for a thing [ a thing ] to observe by practical use level only after the polyetherimide resin of heat-resistant resin and polyether sulphone resin cannot show soldering nature at all, and I hear that they are level which is not practical as for polycarbonate resin and polyarylate resin, there are and they blend both resin. Moreover, it is a surprising thing that they can demonstrate practical soldering nature even if they lessen a mixed rate, although polyester resin and polyamide resin all show good soldering nature in independent [ its ].

[0028] Melting combination of said resin admixture can be carried out with kneading machines, such as the usual biaxial extruder, a kneader, and a ko kneader. It has become clear that the kneading temperature of combination resin affects direct soldering nature, and a property with better direct soldering nature setting up highly a temperature setup of the kneading machine at the time of mixing is acquired. A temperature setup of 360 degrees C or more is especially desirable 320 degrees C or more. In said resin admixture, other heat-resistant thermoplastics can be added in the range which does not spoil direct soldering nature and thermal resistance. As for the heat-resistant thermoplastics which can be added, what has itself good [ soldering nature ] is desirable, and polyurethane resin, Pori acrylic resin, etc. are mentioned as an example. In said resin admixture, the additive usually used, an inorganic bulking agent, processing aid, a coloring agent, etc. can be added in the range which does not spoil direct soldering nature and thermal resistance.

[0029] The reservation of thermal resistance [ direction ] and the balance of soldering nature which furthermore extruded as a configuration of the insulating layer of multilayer insulated wire, combining this resin mixture more than two-layer, and were covered are good, and desirable. Moreover, as thermoplastics which has the soldering nature which can be formed as insulating layers other than this resin admixture, the resin which uses a polyamide as a principal component, and the resin which uses polyester as a principal component can be used, and Nylon 12, nylon 6, nylon 6, 6, nylon 4, and 6 grades can specifically be used as polyamide resin. It is desirable to use nylon 6, 6, and nylon 4 and 6 for balancing thermal resistance and soldering nature especially, and when the coil workability of an electric wire is further taken into consideration, it is most desirable to make these form in the maximum upper layer. Moreover, as polyester resin, it consists of aromatic series dicarboxylic acid and aliphatic series diol, and polybutylene terephthalate (PBT), polyethylene terephthalate (PET), polycyclohexane dimetan terephthalate (PCT), polyethylenenaphthalate (PEN), etc. can be used. Next, as long as there is no trouble in thermal resistance and soldering nature about other resin, an additive, etc., combination addition of this resin admixture or this polyamide system resin, and/or the polyester system resin may be carried out at the resin used as a principal component. moreover, a conductor -- when extruding and covering this resin admixture upwards, soldering nature is greatly improved for the direction which does not perform preheating of a conductor. Even when becoming hot beforehand, as for temperature, it is desirable to set it as the temperature of 140 degrees C or less. namely, a conductor -- soldering nature improves [ that the adhesive property of a conductor and this resin admixture enveloping layer becomes weaker, and that this resin mixing enveloping layer produces 10 - 30% of big heat shrink in a longitudinal direction at the time of soldering ] conjointly by not heating. As a conductor used for this invention, the multi-core stranded wire which twisted two or more [ of two or more or enamel insulated wire of the insulated wire which prepared the enamel enveloping layer and the light-gage insulating layer, or metal open wire, or light-gage insulated wire ] can be used for metal open wire (single track) or metal open wire. The number of stranded wires of these stranded wires can carry out optional selection by the RF application. Moreover, you may not be a stranded wire when there are many line centers (strand) (for example, 19-, 37-strand). When it is not a stranded wire, it may also be good to bundle two or more strands to abbreviation parallel, or the tied thing may be twisted in the very big pitch. In any case, it is desirable to make it a cross section serve as an approximate circle form. however, a light-gage insulating material -- ester imide denaturation polyurethane resin, urea denaturation polyurethane resin,

polyester imide resin, etc. -- like -- resin with soldering nature good in itself etc. -- it is necessary to be -- for example, the Hitachi Chemical Co., Ltd. make -- trade name WD-4305 and the Totoku Toryo Co., Ltd. make -- trade name TSF-200, TPU-7000, and great Nissei-ized company make -- trade name FS-304 etc. can be used. Furthermore, solder or carrying out tinning also become a means to improve a soldering property at a conductor. When the desirable embodiment of this invention is raised, a heat-resistant multilayer insulated wire Extrusion covering is carried out and the insulating layer of the 1st layer of desired thickness Mino is formed in a periphery. the resin or resin admixture for [ one layer ] -- a conductor -- subsequently It is manufactured by carrying out extrusion covering of the resin or resin admixture for two-layer eyes, forming the insulating layer of a desired thickness Mino two-layer eye, carrying out extrusion covering of the resin or resin admixture for [ three layer ] further at the periphery of the insulating layer of this two-layer eye, and forming the insulating layer of the 3rd layer of desired thickness Mino in the periphery of this insulating layer of the 1st layer. Thus, as for the thickness of the whole extrusion covering insulating layer formed, in three layers, it is desirable to make it be within the limits of 60-180 micrometers. This may have the large fall of the electrical property of a heat-resistant multilayer insulated wire with which the thickness of the whole insulating layer was obtained by 60 micrometers or less, may be unsuitable for practical use, and is because aggravation of soldering nature may become remarkable in 180 micrometers or more. The still more desirable range is 70-150 micrometers. Moreover, as for the thickness of above-mentioned each class of three layers, managing to 20-60 micrometers is desirable.

[0030] In the multilayer insulated wire of this invention, it has at least one layer of layers of this resin admixture as an insulating layer, and can consider as the layer which uses as a principal component the thermoplastics which can solder the remaining insulating layer, and thermal resistance and both the properties of soldering nature can be satisfied. Although it still is not certain about the reason, it is presumed as follows. That is, from high polyetherimide resin, heat-resistant polyether sulphone resin, and heat-resistant it, it is important that they are heat-resistant low polycarbonate resin, polyarylate resin, polyester resin, and polyamide resin, molecular weight falls, the melt viscosity of admixture is reduced, and this resin admixture generates the component which moreover shows a flux operation, when a part of heat-resistant low resin pyrolyzes at the time of these resin kneading. When extrusion covering is carried out by this, in spite of having high thermal resistance, to be able to discover soldering nature is considered by it. Moreover, when covering formation of this resin admixture was carried out at the 1st layer, it became clear by not performing preheating of a conductor, since heat shrink nature is large, but reducing adhesion that soldering nature level was further improvable. Not to mention satisfying IEC950 specification, since an insulating-tape volume has not been carried out, it can miniaturize, and moreover, since thermal resistance and the RF property are high, the transformer which used the multilayer insulated wire of this invention can respond also to a severe design.

[0031] The multilayer insulated wire of this invention can be used also for what type containing what was shown by said drawing 1 and 2 of transformer as a coil. Although it is common to coil a primary coil and a secondary coil in the shape of a layer on a core as for such a transformer, the transformer (JP,5-152139,A) around which the primary coil and the secondary coil were coiled by turns is sufficient. Moreover, although the transformer of this invention may use the above-mentioned multilayer insulated wire for both a primary coil and a secondary coil, one of the two's use is sufficient as it either. Moreover, when the multilayer insulated wire of this invention consists of two-layer, among both coils, at least one layer of insulating barrier layers can be made to be able to intervene, and it can be used (for example, when each of primary coils and secondary coils uses an enameled wire for two-layer insulated wire or one of the two and already uses two-layer insulated wire for one of the two).

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**DESCRIPTION OF DRAWINGS**

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[Brief Description of the Drawings]

[Drawing 1] It is the sectional view showing the example of the transformer of the structure which uses three-layer insulated wire as a coil.

[Drawing 2] It is the sectional view showing one example of the transformer of structure conventionally.

[Drawing 3] It is the schematic diagram showing the measuring method of a coefficient of static friction.

[Description of Notations]

- 1 Ferrite Core
- 2 Bobbin
- 3 Insulating Barrier
- 4 Primary Winding
- 4a Conductor
- 4b, 4c, and 4d Insulating layer
- 5 Insulating Tape
- 6 Secondary Winding
- 6a Conductor
- 6b, 6c, and 6d Insulating layer
- 7 Multilayer Insulated Wire
- 8 Load Plate
- 9 Block
- 10 Load

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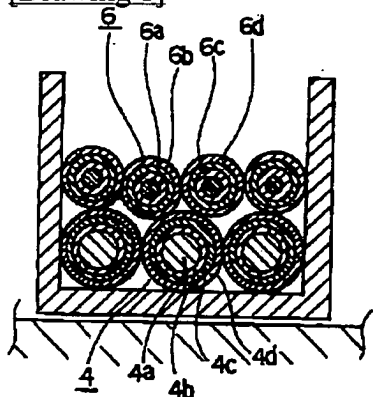
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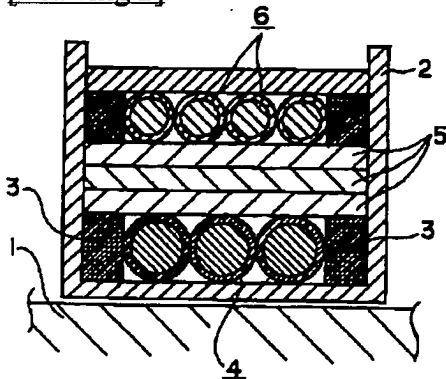
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**DRAWINGS**

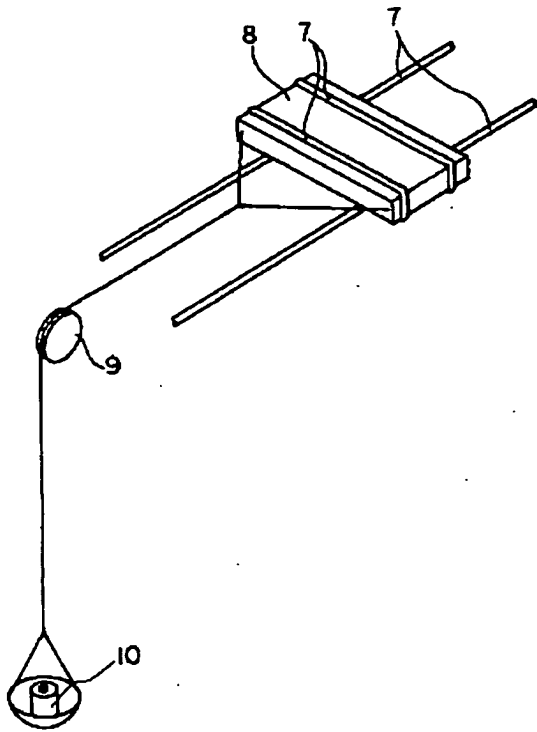
[Drawing 1]



[Drawing 2]



[Drawing 3]



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## DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] About the transformer using the multilayer insulated wire and it which an insulating layer becomes from the extrusion enveloping layer more than two-layer, this invention is excellent in thermal resistance with the outstanding soldering nature to which it is removed for a short time and can make solder adhere to a conductor in more detail if an insulating layer is immersed in a solder bath, and relates to the transformer using multilayer insulated wire and it useful as the coil and lead wire of the transformer built into the electrical and electric equipment etc.

[0002]

[Description of the Prior Art] the structure of a transformer -- IEC-standards (International Electrotechnical Communication Standard) Pub.950 etc. -- it is specified. Namely, the thickness of that the insulating layer (the enamel coat which covers a conductor is not recognized as an insulating layer) of at least three layers is formed between a primary winding and a secondary winding in a coil by such specification, or an insulating layer is 0.4mm or more, Although the creeping distance of a primary winding and a secondary winding changes also with applied voltage, when 3000V are impressed to that it is 5mm or more, and secondary [ the upstream and secondary ], bearing 1 minute or more etc. is specified. As a transformer which has taken the mainstream seat under such specification now, structure which is illustrated in the sectional view of drawing 2 is adopted. After arranging the insulating barrier 3 for securing an insulating tape 5 on this primary winding 4, and securing the creeping distance on at least three-layer winding and also this insulating tape, after the primary winding 4 by which enamel covering was carried out in the condition that the insulating barrier 3 for securing the creeping distance has been arranged is wound around the peripheral surface both-sides edge of the bobbin 2 on a ferrite core 1, it is the structure where the secondary winding 6 by which enamel covering was similarly carried out was wound.

[0003] By the way, as drawing 1 showed in recent years instead of the transformer of the cross-section structure shown in drawing 2 , the transformer of the structure which contains neither the insulating barrier 3 nor the insulating-tape layer 5 is beginning to appear. Compared with the transformer of the structure of drawing 2 , this transformer could miniaturize the whole and is equipped with the advantage with the omissible winding activity of an insulating tape. the primary coil 4 and the secondary coil 6 which are used when manufacturing the transformer shown by drawing 1 -- the conductor of either or both -- it is necessary to form the insulating layers 4b (6b), 4c (6c), and 4d (6d) of at least three layers in the periphery of 4a (6a) by relation with said IEC standards carried out.

[0004] An insulating tape is wound around the periphery of a conductor as such a coil, the insulating layer of the 1st layer is formed, further, an insulating tape is wound on it and what forms the insulating layer of a two-layer eye and the insulating layer of the three-tiered structure which carries out sequential formation and carries out interlaminar peeling of the insulating layer of the 3rd layer mutually is known. Moreover, the coil which carries out extrusion covering of the fluororesin one by one, and makes an insulating layer the extrusion enveloping layer of a three-tiered structure as a whole at the periphery of

the conductor with which enamel covering by polyurethane was made is known (application-for-utility-model-registration Taira No. 56112 [ three to ] official report).

[0005] However, in the case of the aforementioned insulating-tape volume, since the activity to wind is unescapable, productivity is remarkably low and, for the reason, electric-wire cost is very high. Moreover, it will also be difficult to gather manufacture speed, since there is a property in which an appearance condition will get worse if the cost of resin is high although it has the advantage that thermal resistance is good since the insulating layer is formed by fluorine system resin in the case of the aforementioned fluororesin extrusion, and it pulls by the high shear rate further, and will become what has high electric-wire cost like an insulating-tape volume. Furthermore, in the case of this insulating layer, since it is unremovable even if immersed in a solder bath, there is a problem that it exfoliates with an unreliable mechanical means, and the insulating layer of a terminal must be further soldered or sticking-by-pressure connected that top on the occasion of terminal processing performed when connecting insulated wire to a terminal.

[0006] Two or more extrusion insulating layers by the admixture which mixed the ionomer which used polyethylene terephthalate as base resin and, on the other hand, made the metal salt a part of carboxyl group of an ethylene-methacrylic acid copolymer at this are formed. Multilayer insulated wire which covered nylon as the maximum upper layer of an insulating layer is put in practical use. This Electric-wire cost (ingredient cost and productivity), soldering nature (carry out the direct continuation of insulated wire and the terminal), And coil workability (when winding insulated wire around a bobbin, both insulated wire is worn) a guide nozzle -- rubbing -- etc. -- what an insulating layer will be torn and the electrical property of a coil will be spoiled -- there is nothing -- it excels (a U.S. Pat. No. 5,606,152 specification, JP,6-223634,A). Furthermore, in order to raise thermal resistance, what changed polycyclohexane dimethylene terephthalate (PCT) into what is used as base resin from what uses the aforementioned polyethylene terephthalate as base resin is proposed. However, although these things pass E sorts of heatproofs in the test method with which thermal resistance was based on the schedule U of the 2.9.4.4th term of IEC950 specification (electric wire), and the schedule C of the 1.5.3rd term (transformer), it cannot respond to the rise of a demand level to thermal resistance in recent years, and becomes a rejection at B sorts of heatproofs.

[0007]

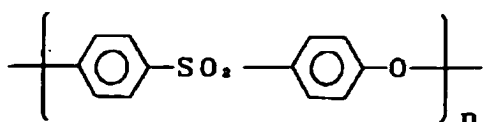
[Problem(s) to be Solved by the Invention] In order to solve such a problem, this invention is excellent in thermal resistance, soldering nature, and coil workability, and aims at offering a suitable multilayer insulated wire also for industrial production. Furthermore, this invention is excellent in the electrical property which comes to wind an insulated wire excellent in such thermal resistance, and soldering nature and coil workability, and aims at offering a reliable transformer.

[0008]

[Means for Solving the Problem] The above-mentioned technical problem of this invention was attained by the transformer which used the following multilayer insulated wire and this. It is the multilayer insulated wire which comes to have the extrusion insulating layer in which soldering more than two-layer [ which covers a conductor and said conductor ] is possible. namely, this invention -- (1) -- As opposed to at least one sort of (Resin A) 100 weight sections as which at least one layer of said insulating layer was chosen from polyetherimide resin and polyether sulphone resin The multilayer insulated wire characterized by being formed from the resin admixture which blended at least one sort of resin (B) chosen from polycarbonate resin, polyarylate resin, polyester resin, and polyamide resin more than 10 weight sections, (2) Multilayer insulated wire given in (1) term characterized by said resin (A) being polyether sulphone resin, (3) Multilayer insulated wire given in (1) term characterized by said resin (B) being polycarbonate resin, (4) Multilayer insulated wire given in (1) term characterized by for said resin (A) being polyether sulphone resin, and said resin (B) being polycarbonate resin, (5) The multilayer insulated wire of (1), (2), (3), or (4) term publication characterized by said resin (A) being polyether sulphone resin which comes to have the repeating unit expressed with the following type,

[0009]

[Formula 2]



[0010] (n shows a positive integer among a formula.)

(6) The multilayer insulated wire of any one publication of the (1) - (5) term with which said resin admixture is characterized by carrying out 10-70 weight section combination of the resin (B) to the (Resin A) 100 weight section, (7) Without heating a conductor beforehand to the temperature which does not exceed 140 degrees C or carrying out a preheating In said insulating layer the multilayer insulated wire of any one publication of the (1) - (6) term characterized by besides coming to cover said insulating layer, and (8) -- The multilayer insulated wire of any one publication of the (1) - (7) term characterized by forming insulating layers other than at least one layer formed of the aforementioned resin admixture with thermoplastic polyester resin or polyamide resin, (9) The transformer characterized by coming to use the multilayer insulated wire of any one publication of the (1) - (8) term characterized by the maximum upper layer of said insulating layer consisting of polyamide resin and the multilayer insulated wire of any one publication of the (10) aforementioned (1) - (9) term is offered.

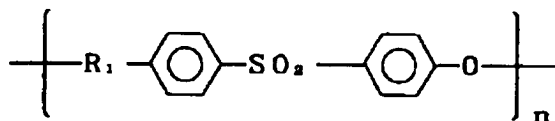
[0011]

[Embodiment of the Invention] In the multilayer insulated wire of this invention, an insulating layer consists of more than two-layer, and consists of three layers preferably. The number of them is at least one, and when thinking thermal resistance as important, as for the insulating layer which consists of the aforementioned resin (A) and admixture of (B) among this insulating layer, it is desirable that all layers consist of this admixture. Moreover, it is desirable to form the maximum upper layer of an insulating layer in a lubricative good resin layer, when thinking coil workability as important, and to use the other layer as the layer which consists of this resin (A) and admixture of (B). Said resin (A) is resin with high thermal resistance, and it can use polyether sulphone resin as this resin, choosing it from a well-known thing. What this polyether sulphone resin is expressed with the following general formula (1) to is used preferably.

[0012]

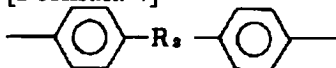
[Formula 3]

一般式 (1)



[0013] The inside of [type and R1 are single bond or -R2-O- (R2 is a phenylene group, a BIFENIRIREN radical, and [0014])

[Formula 4]



[0015] It is (R3 shows alkylene groups, such as -C(CH<sub>3</sub>)<sub>2</sub>- and -CH<sub>2</sub>-), and is R2. The radical may have the substituent further. It is shown. n shows a positive integer.]

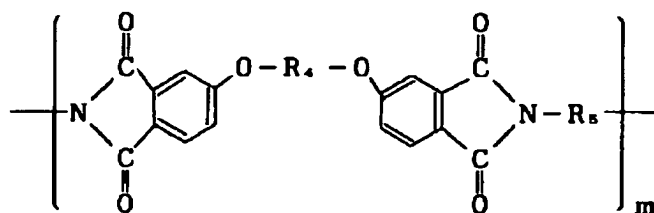
[0016] The manufacture approach of this resin itself is well-known, and the method of reacting and manufacturing dichloro diphenylsulfone, Bisphenol S, and potassium carbonate in a high-boiling point solvent, as an example, is raised. As commercial resin, there are Leh Dell A, Victrex PES (Sumitomo Chemical Co., Ltd. make, trade name) and Leh Dell R-UDEL (the product made from Amoco, trade name), etc. Moreover, polyetherimide resin can be used as said resin (A). This polyetherimide resin is also well-known with the manufacture approach, as an example, it carries out solution polycondensation, using 2 and 2' - screw [3-(3, 4-dicarboxy phenoxy)-phenyl] pro pansy acid-anhydride, 4, 4'-diamino diphenylmethane as a solvent, and orthochromatic-dichlorobenzene is compounded in it. This

polyetherimide resin is preferably expressed with a general formula (2).

[0017]

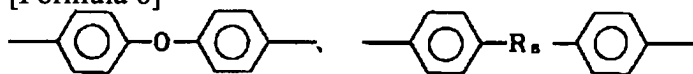
[Formula 5]

一般式 (2)



[0018] The inside of [type, R4, and R5 are the phenylene group which may have the substituent, a BIFENIRIREN radical, and [0019].

[Formula 6]



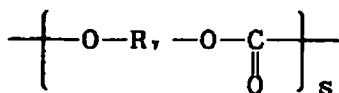
[0020] (R6 is the alkylene group of carbon numbers 1-7 preferably among a formula, and they are methylene, ethylene, and a propylene (especially preferably isopropylidene) preferably) Or a naphthylene radical is shown and alkyl groups (methyl, ethyl, etc.) etc. are raised as a substituent in case these radicals have a substituent. m is a positive integer.] As commercial resin, there is ULTEM (GE plastics company make, trade name) etc.

[0021] As for a resin constituent, soldering nature is given by mixing heat-resistant resin (A) and resin (B) in this invention. The aforementioned polycarbonate resin and polyarylate resin which are used as this resin (B), polyester resin, and especially polyamide resin are not limited. What is manufactured by the approach well-known as a raw material in dihydric alcohol, a phosgene, etc. can be used for polycarbonate resin. As commercial resin, there are Lexan (GE plastics company make, trade name), a pan light (Teijin formation shrine make, a trade name), a you pyrone (the Mitsubishi Gas Chemical Co., Inc. make, trade name), etc. A well-known thing can be used for the polycarbonate resin used for this invention. For example, there are some which are expressed with a general formula (3).

[0022]

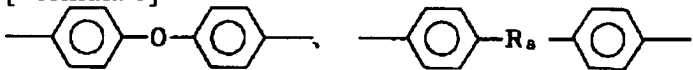
[Formula 7]

一般式 (3)



[0023] The inside of [type and R7 are the phenylene group which may have the substituent, a BIFENIRIREN radical, and [0024].

[Formula 8]



[0025] (R8 is the alkylene group of carbon numbers 1-7 preferably among a formula, and they are methylene, ethylene, and a propylene (especially preferably isopropylidene) preferably) Or a naphthylene radical is shown and alkyl groups (methyl, ethyl, etc.) etc. are raised as a substituent in case these radicals have a substituent. s is a positive integer.]

Moreover, polyarylate resin is manufactured by interfacial polymerization, and bisphenol A dissolved in

the alkali water solution, and the call / iso mixing phthalic-acid chloride dissolved in organic solvents, such as halogenated hydrocarbon, are made to react in ordinary temperature, and it compounds it. There is a U polymer (the Unitika, Ltd. make, trade name) etc. as commercial resin. Moreover, what is manufactured by the approach well-known as a raw material in dihydric alcohol, divalent aromatic carboxylic acid, etc. can be used for polyester resin. As commercial resin, polyethylene terephthalate (PET) system resin is a BAIRO pet (the Toyobo Co., Ltd. make, trade name), a bell pet (the Kanebo, Ltd. make, trade name), and Teijin PET (the Teijin, Ltd. make, trade name). As for polyethylenenaphthalate (PEN) system resin, Teijin PEN (the Teijin, Ltd. make, trade name) and polycyclohexane-dimethylene-terephthalate (PCT) system resin have EKUTA (the Toray Industries, Inc. make, trade name) etc.

[0026] Furthermore, what is manufactured by the approach well-known as a raw material in diamine, dicarboxylic acid, etc. can be used for polyamide resin. As commercial resin, nylon 6 and 6 have Amilan (the Toray Industries, Inc. make, trade name), Zytel (the Du Pont make, trade name), and Mara Neal (the Unitika, Ltd. make, trade name), and, as for Unitika Nylon 46 (the Unitika, Ltd. make, trade name), nylon 6, and T, nylon 4 and 6 has Arlen (Mitsui petrochemical company make, trade name) etc.

[0027] Moreover, it is presumed that resin (B), such as polycarbonate resin blended with the resin (A) which has thermal resistance in this invention, polyarylate resin, polyester resin, and polyamide resin, generates components which some resin decomposes at the time of kneading with this heat-resistant resin (A) and soldering as an insulated wire, and show a flux operation at it, such as carboxylic acids, amines, alcohols, and aldehydes. In this invention, the loadings of the resin (B) to the (Resin A) 100 weight section are more than 10 weight sections. Resin 100 (A) To the weight section, although resin (B) of thermal resistance is expensive in under 10 weight sections, soldering nature is not obtained. Although the upper limit of the loadings of resin (B) is defined in consideration of the heat-resistant level to demand, it is below the 100 weight sections preferably. In maintaining high soldering nature and realizing heat-resistant high level especially, as for the amount of the resin (B) used, it is desirable to carry out to below 70 weight sections, and the range in which the balance of both this property is especially good, and suitable serves as resin (B) 20 - 50 weight sections. Soldering nature can improve the soldering nature of itself especially for a thing [ a thing ] to observe by practical use level only after the polyetherimide resin of heat-resistant resin and polyether sulphone resin cannot show soldering nature at all, and I hear that they are level which is not practical as for polycarbonate resin and polyarylate resin, there are and they blend both resin. Moreover, it is a surprising thing that they can demonstrate practical soldering nature even if they lessen a mixed rate, although polyester resin and polyamide resin all show good soldering nature in independent [ its ].

[0028] Melting combination of said resin admixture can be carried out with kneading machines, such as the usual biaxial extruder, a kneader, and a ko kneader. It has become clear that the kneading temperature of combination resin affects direct soldering nature, and a property with better direct soldering nature setting up highly a temperature setup of the kneading machine at the time of mixing is acquired. A temperature setup of 360 degrees C or more is especially desirable 320 degrees C or more. In said resin admixture, other heat-resistant thermoplastics can be added in the range which does not spoil direct soldering nature and thermal resistance. As for the heat-resistant thermoplastics which can be added, what has itself good [ soldering nature ] is desirable, and polyurethane resin, Pori acrylic resin, etc. are mentioned as an example. In said resin admixture, the additive usually used, an inorganic bulking agent, processing aid, a coloring agent, etc. can be added in the range which does not spoil direct soldering nature and thermal resistance.

[0029] The reservation of thermal resistance [ direction ] and the balance of soldering nature which furthermore extruded as a configuration of the insulating layer of multilayer insulated wire, combining this resin mixture more than two-layer, and were covered are good, and desirable. Moreover, as thermoplastics which has the soldering nature which can be formed as insulating layers other than this resin admixture, the resin which uses a polyamide as a principal component, and the resin which uses polyester as a principal component can be used, and Nylon 12, nylon 6, nylon 6, 6, nylon 4, and 6 grades can specifically be used as polyamide resin. It is desirable to use nylon 6, 6, and nylon 4 and 6 for



balancing thermal resistance and soldering nature especially, and when the coil workability of an electric wire is further taken into consideration, it is most desirable to make these form in the maximum upper layer. Moreover, as polyester resin, it consists of aromatic series dicarboxylic acid and aliphatic series diol, and polybutylene terephthalate (PBT), polyethylene terephthalate (PET), polycyclohexane dimethane terephthalate (PCT), polyethyleneterephthalate (PEN), etc. can be used. Next, as long as there is no trouble in thermal resistance and soldering nature about other resin, an additive, etc., combination addition of this resin admixture or this polyamide system resin, and/or the polyester system resin may be carried out at the resin used as a principal component. moreover, a conductor -- when extruding and covering this resin admixture upwards, soldering nature is greatly improved for the direction which does not perform preheating of a conductor. Even when becoming hot beforehand, as for temperature, it is desirable to set it as the temperature of 140 degrees C or less. namely, a conductor -- soldering nature improves [ that the adhesive property of a conductor and this resin admixture enveloping layer becomes weaker, and that this resin mixing enveloping layer produces 10 - 30% of big heat shrink in a longitudinal direction at the time of soldering ] conjointly by not heating. As a conductor used for this invention, the multi-core stranded wire which twisted two or more [ of two or more or enamel insulated wire of the insulated wire which prepared the enamel enveloping layer and the light-gage insulating layer, or metal open wire, or light-gage insulated wire ] can be used for metal open wire (single track) or metal open wire. The number of stranded wires of these stranded wires can carry out optional selection by the RF application. Moreover, you may not be a stranded wire when there are many line centers (strand) (for example, 19-, 37-strand). When it is not a stranded wire, it may also be good to bundle two or more strands to abbreviation parallel, or the tied thing may be twisted in the very big pitch. In any case, it is desirable to make it a cross section serve as an approximate circle form. however, a light-gage insulating material -- ester imide denaturation polyurethane resin, urea denaturation polyurethane resin, polyester imide resin, etc. -- like -- resin with soldering nature good in itself etc. -- it is necessary to be -- for example, the Hitachi Chemical Co., Ltd. make -- trade name WD-4305 and the Totoku Toryo Co., Ltd. make -- trade name TSF-200, TPU-7000, and great Nissei-ized company make -- trade name FS-304 etc. can be used. Furthermore, solder or carrying out tinning also become a means to improve a soldering property at a conductor. When the desirable embodiment of this invention is raised, a heat-resistant multilayer insulated wire Extrusion covering is carried out and the insulating layer of the 1st layer of desired thickness Mino is formed in a periphery. the resin or resin admixture for [ one layer ] -- a conductor -- subsequently It is manufactured by carrying out extrusion covering of the resin or resin admixture for two-layer eyes, forming the insulating layer of a desired thickness Mino two-layer eye, carrying out extrusion covering of the resin or resin admixture for [ three layer ] further at the periphery of the insulating layer of this two-layer eye, and forming the insulating layer of the 3rd layer of desired thickness Mino in the periphery of this insulating layer of the 1st layer. Thus, as for the thickness of the whole extrusion covering insulating layer formed, in three layers, it is desirable to make it be within the limits of 60-180 micrometers. This may have the large fall of the electrical property of a heat-resistant multilayer insulated wire with which the thickness of the whole insulating layer was obtained by 60 micrometers or less, may be unsuitable for practical use, and is because aggravation of soldering nature may become remarkable in 180 micrometers or more. The still more desirable range is 70-150 micrometers. Moreover, as for the thickness of above-mentioned each class of three layers, managing to 20-60 micrometers is desirable.

[0030] In the multilayer insulated wire of this invention, it has at least one layer of layers of this resin admixture as an insulating layer, and can consider as the layer which uses as a principal component the thermoplastics which can solder the remaining insulating layer, and thermal resistance and both the properties of soldering nature can be satisfied. Although it still is not certain about the reason, it is presumed as follows. That is, from high polyetherimide resin, heat-resistant polyether sulphone resin, and heat-resistant it, it is important that they are heat-resistant low polycarbonate resin, polyarylate resin, polyester resin, and polyamide resin, molecular weight falls, the melt viscosity of admixture is reduced, and this resin admixture generates the component which moreover shows a flux operation, when a part of heat-resistant low resin pyrolyzes at the time of these resin kneading. When extrusion

covering is carried out by this, in spite of having high thermal resistance, to be able to discover soldering nature is considered by it. Moreover, when covering formation of this resin admixture was carried out at the 1st layer, it became clear by not performing preheating of a conductor, since heat shrink nature is large, but reducing adhesion that soldering nature level was further improvable. Not to mention satisfying IEC950 specification, since an insulating-tape volume has not been carried out, it can miniaturize, and moreover, since thermal resistance and the RF property are high, the transformer which used the multilayer insulated wire of this invention can respond also to a severe design.

[0031] The multilayer insulated wire of this invention can be used also for what type containing what was shown by said drawing 1 and 2 of transformer as a coil. Although it is common to coil a primary coil and a secondary coil in the shape of a layer on a core as for such a transformer, the transformer (JP,5-152139,A) around which the primary coil and the secondary coil were coiled by turns is sufficient. Moreover, although the transformer of this invention may use the above-mentioned multilayer insulated wire for both a primary coil and a secondary coil, one of the two's use is sufficient as it either. Moreover, when the multilayer insulated wire of this invention consists of two-layer, among both coils, at least one layer of insulating barrier layers can be made to be able to intervene, and it can be used (for example, when each of primary coils and secondary coils uses an enameled wire for two-layer insulated wire or one of the two and already uses two-layer insulated wire for one of the two).

[0032]

[Example] Next, this invention is further explained to a detail based on an example.

as one to examples 1-18 and example of comparison 5 conductor -- the annealed copper wire of 0.4mm of wire sizes, and the annealed copper wire of 0.15mm of wire sizes -- the Hitachi Chemical Co., Ltd. make -- the stranded wire which twisted seven insulating line centers which covered insulating-varnish WD-4305 to 8-micrometer thickness was prepared. combination (a presentation shows the weight section) and thickness of the resin for extrusion covering of each class shown in Table 1, 2, and 3 -- it is -- a conductor -- upwards, it extruded one by one upwards, it covered, and multilayer insulated wire was manufactured (surface treatment: refrigerating-machine-oil use) . Various kinds of properties by the following specification were measured about the obtained multilayer insulated wire.

[0033] O Soldering nature : measure time amount (second) until it is immersed in melting solder with a temperature of 450 degrees C and solder adheres the part of about 40mm of ends of an electric wire to the immersed 30mm part. It means excelling in soldering nature, so that this time amount is short. A numeric value is the average of  $n=3$ .

O Heat-resistant (1) : the following test method based on the schedule U of the 2.9.4.4th term of IEC-standards 950 specification (electric wire) and the schedule C of the 1.5.3rd term (transformer) estimated. while covering multilayer insulated wire over a mandrel with a diameter of 6mm for load 118MPa (12kg/mm<sup>2</sup>) -- 10 turn volume attachment, 225-degree-C (E sorts of 215 degrees C) 1-hour heating, and 175 more degree-C (E sorts of 165 degrees C) 72 hours -- heating -- 25 more degree-C95% of ambient atmosphere -- 48 hours -- holding -- after that -- immediately -- 3000V If impress an electrical potential difference and it is not short-circuited for 1 minute, it judges with B sort success. ( $n=5$  estimates a judgment.) It will become a rejection if  $n=1$  is set to NG.

O Coil workability (coefficient of static friction) : the measuring method of a coefficient of static friction is shown in drawing 3 . 7 shows multilayer insulated wire, and 8 is a load plate and sets the mass to  $W_g$ . Similarly, 9 shows a block and 10 shows a load. When mass of the load 10 when the load plate 8 begins to move is set to  $F_g$ , it is coefficient-of-static-friction  $=F/W$  to calculate. Surface skid nature is so good that this numeric value is small, and coil workability is also good.

[0034]

[Table 1]

表1

		実施例1	実施例2	実施例3	比較例1	比較例2	比較例3	比較例4	比較例5
導体		単線	単線	単線	単線	単線	単線	単線	単線
製造速度 (m/分)		200	200	200	200	200	200	50	200
予熱温度 (°C)		200	200	200	なし	なし	200	200	なし
混練温度 (°C)		360	360	360	360	360	なし	なし	360
第1層	樹脂	PEI <sup>*1</sup>	100	100	—	100	—	—	—
	(A)	PES <sup>*2</sup>	—	—	100	—	100	—	100
		PAR <sup>*3</sup>	—	—	—	—	—	—	—
	樹脂	PC-1 <sup>*4</sup>	40	20	—	—	100	—	—
	(B)	PC-1 <sup>*5</sup>	—	—	40	—	—	—	5
		PCT-2 <sup>*9</sup>	—	—	—	—	—	—	—
		PA-1 <sup>*6</sup>	—	—	—	—	—	—	—
	PF <sup>*8</sup>	—	—	—	—	—	—	100	—
	膜厚 (μm)	30	30	33	30	33	30	30	33
	樹脂	PEI <sup>*1</sup>	100	100	—	100	—	—	—
第2層	(A)	PES <sup>*2</sup>	—	—	100	—	100	—	100
		PAR <sup>*3</sup>	—	—	—	—	—	—	—
	樹脂	PC-1 <sup>*4</sup>	40	20	—	—	100	—	—
	(B)	PC-2 <sup>*5</sup>	—	—	40	—	—	—	5
		PCT-1 <sup>*9</sup>	—	—	—	—	—	—	—
		PCT-2 <sup>*10</sup>	—	—	—	—	—	—	—
		PA-2 <sup>*7</sup>	—	—	—	—	—	—	—
	PF <sup>*8</sup>	—	—	—	—	—	—	100	—
	膜厚 (μm)	30	30	33	30	33	30	30	33
	樹脂	PEI <sup>*1</sup>	100	100	—	100	—	—	—
第3層	(A)	PES <sup>*2</sup>	—	—	100	—	—	—	—
	樹脂	PC-1 <sup>*4</sup>	40	20	—	—	100	—	—
	(B)	PC-2 <sup>*5</sup>	—	—	40	—	—	—	—
		PA-2 <sup>*7</sup>	—	—	—	—	—	—	—
	PF <sup>*8</sup>	—	—	—	—	—	—	100	—
	PCT-1 <sup>*9</sup>	—	—	—	—	—	—	—	—
	PA-2 <sup>*7</sup>	—	—	—	—	100	—	—	100
	膜厚 (μm)	30	30	33	30	33	30	30	33
	全体膜厚 (μm)	90	90	100	90	100	90	90	100
	電線外觀	良好	良好	良好	良好	良好	良好	良好	不良
半田付け性		5.0	6.0	4.0	20秒以上	20秒以上	10.0	20秒以上	20秒以上
耐熱性 (I) B種		合格	合格	合格	合格	合格	不合格	合格	合格
E種		—	—	—	—	—	不合格	—	—
静摩擦係数		0.13	0.14	0.16	0.16	0.08	0.17	0.06	0.08

- (注) #1 PET:ULTEM1000 (日本アイ・エス・エス社製、商品名) 利エーテルイミド樹脂  
 #2 PES:ピクトレックスPES 4100G(住友化学社製、商品名) 利エーテルスルホン樹脂  
 #3 PAR:ポリマー-U-100(エチカ社製、商品名) 利アリレート樹脂  
 #4 PC-1:レキシSP-1010 (Lexan) (日本アイ・エス・エス社製、商品名) 利カーボネート樹脂  
 #5 PC-2:レキシSP-1210 (Lexan) (日本アイ・エス・エス社製、商品名) 利カーボネート樹脂  
 #6 PA-1:7-レキAE-4200 (ARLEN) (三井石油化学社製、商品名) 利アミド樹脂 (ナイロン6, T)  
 #7 PA-2:F-5001 (エチカ社製、商品名) 利アミド樹脂 (ナイロン4, 6)  
 #8 PF:テフロ100J (三井テフロポリマー社製、商品名) フッ素樹脂  
 #9 PCT-1:エクタ-DA (EKTAR) (東レ社製、商品名) 利シクロヘキサンジメチレンテレフタレート樹脂  
 #10 PCT-2:エクタ-676 (EKTAR) (東レ社製、商品名) 利シクロヘキサンジメチレンテレフタレート樹脂

[0035]

[Table 2]

表2 (表1の続き)

		実施例4	実施例5	実施例6	実施例7	実施例8	実施例9	実施例10	実施例11
導体		単線	単線	単線	単線	単線	単線	単線	単線
製造速度 (m/分)		200	200	200	200	200	200	200	200
予熱温度 (°C)		200	200	200	200	200	200	200	200
混練温度 (°C)		360	360	360	360	360	360	360	360
第1層	樹脂 (A)	PEI <sup>*1</sup>	50	100	100	100	—	—	—
		PES <sup>*2</sup>	50	—	—	—	100	100	100
		PAR <sup>*3</sup>	—	—	—	40	—	—	65
	樹脂 (B)	PC-1 <sup>*4</sup>	—	—	—	—	—	—	—
		PC-2 <sup>*5</sup>	20	40	65	—	15	40	—
		PCT-2 <sup>*10</sup>	—	—	—	40	—	—	—
		PA-1 <sup>*6</sup>	20	—	—	—	—	—	—
	PF <sup>*8</sup>	—	—	—	—	—	—	—	—
	膜厚 (μm)	33	30	30	33	33	33	33	33
	樹脂 (A)	PEI <sup>*1</sup>	50	100	100	100	—	—	—
第2層		PES <sup>*2</sup>	50	—	—	—	100	100	100
		PAR <sup>*3</sup>	—	—	—	40	—	—	65
	樹脂 (B)	PC-1 <sup>*4</sup>	—	40	65	—	—	—	—
		PC-2 <sup>*5</sup>	20	—	—	—	15	40	—
		PCT-1 <sup>*9</sup>	—	—	—	—	—	—	—
		PCT-2 <sup>*10</sup>	—	—	—	40	—	—	—
	PA-2 <sup>*7</sup>	20	—	—	—	—	—	—	—
	PF <sup>*8</sup>	—	—	—	—	—	—	—	—
	膜厚 (μm)	33	30	30	33	33	33	33	33
	樹脂 (A)	PEI <sup>*1</sup>	50	—	—	—	—	—	—
第3層		PES <sup>*2</sup>	50	—	—	—	—	—	—
	樹脂 (B)	PC-1 <sup>*4</sup>	—	—	—	—	—	—	—
		PC-2 <sup>*5</sup>	20	—	—	—	—	—	—
		PA-2 <sup>*7</sup>	20	—	—	—	—	—	—
	PF <sup>*8</sup>	—	—	—	—	—	—	—	—
	PCT-1 <sup>*9</sup>	—	—	—	30	100	—	—	—
	PA-2 <sup>*7</sup>	—	100	100	100	—	100	100	100
	膜厚 (μm)	33	30	30	33	33	33	33	33
	全体膜厚 (μm)	100	90	90	100	100	100	100	100
	電線外觀	良好	良好	良好	良好	良好	良好	良好	良好
半田付け性		3.5	4.0	3.5	4.0	4.0	4.5	2.5	2.5
耐熱性 (1) B種 E種		合格	合格	合格	合格	合格	合格	合格	合格
静摩擦係数		0.12	0.07	0.07	0.09	0.11	0.08	0.07	0.09

- (注) #1 PET:ULTEM1000 (日本エー・プラスティック社製、商品名) 和イ-テルミド樹脂  
 #2 PES:ピクトレックスPES 4100G (住友化学社製、商品名) 和イ-テルミド樹脂  
 #3 PAR:ウレマ-U-100 (エチカ社製、商品名) 和アリレート樹脂  
 #4 PC-1:レキソSP-1010 (Lexan) (日本エー・プラスティック社製、商品名) 和カーボネート樹脂  
 #5 PC-2:レキソSP-1210 (Lexan) (日本エー・プラスティック社製、商品名) 和カーボネート樹脂  
 #6 PA-1:7-レキソAE-4200 (ARLEN) (三井石油化学社製、商品名) 和アミド樹脂 (ナイロン6, T)  
 #7 PA-2:F-5001 (エチカ社製、商品名) 和アミド樹脂 (ナイロン4, 6)  
 #8 PF:テフロ100J (三井化学工業株式会社製、商品名) フッ素樹脂  
 #9 PCT-1:エタラ-DA (EKTAR) (東レ社製、商品名) 和シクロヘキサンジメチレンテレフタレート樹脂  
 #10 PCT-2:エタラ-676 (EKTAR) (東レ社製、商品名) 和シクロヘキサンジメチレンテレフタレート樹脂

[0036]

[Table 3]

表3 (表2の続き)

		実施例12	実施例13	実施例14	実施例15	実施例16	実施例17	実施例18
導体		単線	単線	単線	単線	単線	撚線	撚線
製造速度 (m/分)		200	200	200	200	200	200	200
予熱温度 (°C)		200	140	なし	200	200	200	200
混練温度 (°C)		360	360	360	360	320	360	360
第1層	樹脂 (A)	PEI <sup>*1</sup>	100	100	100	100	100	—
		PES <sup>*2</sup>	—	—	—	—	—	100
		PAR <sup>*3</sup>	—	—	—	—	—	—
	樹脂 (B)	PC-1 <sup>*4</sup>	—	40	40	40	40	40
		PC-2 <sup>*5</sup>	40	—	—	—	—	—
		PCT-2 <sup>*10</sup>	—	—	—	—	—	—
		PA-1 <sup>*6</sup>	—	—	—	—	—	—
	PF <sup>*8</sup>		—	—	—	—	—	—
膜厚 (μm)		30	30	30	60	30	30	33
第2層	樹脂 (A)	PEI <sup>*1</sup>	—	100	100	100	100	—
		PES <sup>*2</sup>	—	—	—	—	—	100
		PAR <sup>*3</sup>	—	—	—	—	—	—
	樹脂 (B)	PC-1 <sup>*4</sup>	100	40	40	40	40	40
		PC-2 <sup>*5</sup>	—	—	—	—	—	—
		PCT-1 <sup>*9</sup>	—	—	—	—	—	—
		PCT-2 <sup>*10</sup>	—	—	—	—	—	—
	PA-2 <sup>*7</sup>	—	—	—	—	—	—	—
PF <sup>*8</sup>		—	—	—	—	—	—	
膜厚 (μm)		30	30	30	60	30	30	33
第3層	樹脂 (A)	PEI <sup>*1</sup>	—	—	—	—	—	—
		PES <sup>*2</sup>	—	—	—	—	—	—
		PAR <sup>*3</sup>	—	—	—	—	—	—
	樹脂 (B)	PC-1 <sup>*4</sup>	—	—	—	—	—	—
		PC-2 <sup>*5</sup>	—	—	—	—	—	—
		PA-2 <sup>*7</sup>	—	—	—	—	—	—
		PF <sup>*8</sup>		—	—	—	—	—
	PCT-1 <sup>*9</sup>		—	—	—	—	—	—
PA-2 <sup>*7</sup>		100	100	100	100	100	100	
膜厚 (μm)		30	30	30	60	30	30	33
全体膜厚 (μm)		90	90	90	180	90	90	100
電線外観		良好	良好	良好	良好	良好	良好	良好
半田付け性		3.0	2.7	2.0	7.0	5.5	4.0	2.5
耐熱性 (I) B種		合格	合格	合格	合格	合格	合格	合格
E種		—	—	—	—	—	—	—
静摩擦係数		0.08	0.07	0.08	0.07	0.08	0.09	0.08

- (注) \*1 PET:ULTEM1000 (日本ゼー・プラスチック社製、商品名) ポリエーテルイミド樹脂  
\*2 PES:ビクトリックスPES 4100G (住友化学社製、商品名) ポリエーテルスルホン樹脂  
\*3 PAR:ウレタン-U-100 (エチカ社製、商品名) ポリウレタン樹脂  
\*4 PC-1:レキサンSP-1010 (Lexan) (日本ゼー・プラスチック社製、商品名) ポリカーボネート樹脂  
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\*9 PCT-1:エクタ-DA (EXTAR) (東レ社製、商品名) シクロヘキサジメチレンテレフタレート樹脂  
\*10 PCT-2:エクタ-676 (EXTAR) (東レ社製、商品名) シクロヘキサジメチレンテレフタレート樹脂

[0037] The thing of the following [ result / which was shown in Table 1, 2, and 3 ] became clear. Since examples 1-4 are formed by the resin admixture within the limits specified by this invention three layers, they show good soldering nature and thermal resistance. Since examples 5, 6, 9-11 are using polyamide resin for the 3rd layer, moreover, they are good, and are [ a coefficient of static friction is also small and ] good. [ of coil workability ] [ of thermal resistance and soldering nature ] Balance is maintained although coil workability is inferior to polyamide resin a little, since polyester resin is used about examples 7 and 8. Although only the 1st layer of this resin admixture is used, since two-layer and a heat-

resistant good ingredient with three layers of sufficient soldering nature are used comparatively, and since the example 12 is using polyamide resin for the 3rd layer, it maintains balance. Since preheat temperature is low and, as for the example 13, it has not carried out the preheating to 140 degrees C, as for the example 14, soldering nature is improved more. Since thickness is as thick as 180 micrometers, as for an example 15, a fall is looked at by the reverse of soldering nature. Since kneading temperature is a lower setup as 320 degrees C, as for an example 16, soldering nature is falling a little. Although examples 17 and 18 are using the enamel stranded wire which can be soldered to a conductor, they have the same good property as single track.

[0038] However, the example 1 of a comparison does not show soldering nature, although only polyetherimide resin of thermal resistance is expensive again, since, as for the example 2 of a comparison, only one layer only of polyether sulphone resin is used. Since it is only polycarbonate resin, the example 3 of a comparison does not almost have thermal resistance, and soldering nature is also bad and is not in practical use level. Furthermore, since the example 4 of a comparison was only a fluororesin, although its coil workability was good and it was high like the example 1 of a comparison, it became clear that soldering nature was not shown. [ of thermal resistance ] Although the example 5 of a comparison has separated from the range specified by this invention, it does not carry out the remaining heat of a conductor, and thermal resistance is good, it does not show [ since there is little this combination resin, ] soldering nature. Moreover, the electric-wire appearance is also getting worse.

[0039] As shown in examples 19-21 and example of comparison 6 table 4, multilayer insulated wire was manufactured completely like the example 3 except having changed the ratio of polyether sulphone resin and polycarbonate resin about the resin admixture (a presentation shows the weight section) of the insulating layer of layer [ 1st ] - the 3rd layer. Moreover, the multilayer insulated wire which formed the 1st layer and the 2nd layer by the resin admixture which consists of polyethylene terephthalate shown in Table 4 and an ionomer as an example 6 of a comparison, and formed the 3rd layer from nylon was manufactured. This insulated wire was examined as follows. In addition, in a heat resistance test (1), the reason for having added the heat resistance test (2) in heat-resistant evaluation is because it can judge only with B sorts or E sorts of success or failures, and in order to show the heat-resistant difference with daily necessities (example 6 of a comparison), it compares a heat-resistant judgment by the heat-resistant simple appraisal method for enameled wires.

O Heat-resistant (2) : it is JIS about extrusion covering insulated wire and nakedness copper wire. Two pieces were twisted based on C3003, it carried out, and after performing heat-treatment of 168 hours (for seven days) at the temperature of 200 degrees C by the condition, dielectric breakdown voltage was measured. Excelling in thermal resistance is shown, so that this value is large, and if the ratio of the dielectric breakdown voltage after the above-mentioned degradation to the dielectric breakdown voltage in the condition before degradation, i.e., the remaining rate after degradation of dielectric breakdown voltage, (%) is 50% or more, it will become an outline and the judgment to satisfy about E sorts of IEC-standards Pub.172 thermal resistance. The trial of soldering nature and a coefficient of static friction was performed like the example 3. The result was shown in Table 4.

[0040]

[Table 4]

表 4

実 施 例	1 9	実施例 3	2 0	2 1	比 較 例 6
第 1 層	PES : PC 100 : 20	PES : PC 100 : 40	PES : PC 100 : 60	PES : PC 100 : 100	PET : 744/マ- 100 : 15
第 2 層	"	"	"	"	"
第 3 層	"	"	"	"	ナイロン 6, 6
耐熱性 (2) (残率%)	103	100	100	87	72
半 田 付 性 (秒)	5.0	4.0	3.0	3.0	1.0
静摩擦係数	0.15	0.16	0.14	0.14	0.08
耐熱性 (1) B種 E種	合格 合格	合格 合格	合格 合格	不合格 合格	不合格 合格

[0041] The result of examples 19-21 is compared with the result of the example 6 of a comparison, and the insulated wire of this invention is excellent in thermal resistance in the top where soldering nature and coil workability are equivalent compared with what covered the nylon layer as an outermost layer on extrusion insulating-layer two-layer [ of the resin admixture of the polyethylene terephthalate resin and the ionomer by which current practical use is carried out ] so that clearly.

[0042]

[Effect of the Invention] By the above explanation, multilayer insulated wire of this invention can be directly soldered at the time of terminal processing so that clearly, and moreover, heat-resistant level is also satisfied enough.

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[Translation done.]

**\* NOTICES \***

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**TECHNICAL FIELD**

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[Field of the Invention] About the transformer using the multilayer insulated wire and it which an insulating layer becomes from the extrusion enveloping layer more than two-layer, this invention is excellent in thermal resistance with the outstanding soldering nature to which it is removed for a short time and can make solder adhere to a conductor in more detail if an insulating layer is immersed in a solder bath, and relates to the transformer using multilayer insulated wire and it useful as the coil and lead wire of the transformer built into the electrical and electric equipment etc.

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[Translation done.]



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**PRIOR ART**

[Description of the Prior Art] the structure of a transformer -- IEC-standards (International Electrotechnical Communication Standard) Pub.950 etc. -- it is specified. Namely, the thickness of that the insulating layer (the enamel coat which covers a conductor is not recognized as an insulating layer) of at least three layers is formed between a primary winding and a secondary winding in a coil by such specification, or an insulating layer is 0.4mm or more, Although the creeping distance of a primary winding and a secondary winding changes also with applied voltage, when 3000V are impressed to that it is 5mm or more, and secondary [ the upstream and secondary ], bearing 1 minute or more etc. is specified. As a transformer which has taken the mainstream seat under such specification now, structure which is illustrated in the sectional view of drawing 2 is adopted. After arranging the insulating barrier 3 for securing an insulating tape 5 on this primary winding 4, and securing the creeping distance on at least three-layer winding and also this insulating tape, after the primary winding 4 by which enamel covering was carried out in the condition that the insulating barrier 3 for securing the creeping distance has been arranged is wound around the peripheral surface both-sides edge of the bobbin 2 on a ferrite core 1, it is the structure where the secondary winding 6 by which enamel covering was similarly carried out was wound.

[0003] By the way, as drawing 1 showed in recent years instead of the transformer of the cross-section structure shown in drawing 2, the transformer of the structure which contains neither the insulating barrier 3 nor the insulating-tape layer 5 is beginning to appear. Compared with the transformer of the structure of drawing 2, this transformer could miniaturize the whole and is equipped with the advantage with the omissible winding activity of an insulating tape. the primary coil 4 and the secondary coil 6 which are used when manufacturing the transformer shown by drawing 1 -- the conductor of either or both -- it is necessary to form the insulating layers 4b (6b), 4c (6c), and 4d (6d) of at least three layers in the periphery of 4a (6a) by relation with said IEC standards carried out.

[0004] An insulating tape is wound around the periphery of a conductor as such a coil, the insulating layer of the 1st layer is formed, further, an insulating tape is wound on it and what forms the insulating layer of a two-layer eye and the insulating layer of the three-tiered structure which carries out sequential formation and carries out interlaminar peeling of the insulating layer of the 3rd layer mutually is known. Moreover, the coil which carries out extrusion covering of the fluororesin one by one, and makes an insulating layer the extrusion enveloping layer of a three-tiered structure as a whole at the periphery of the conductor with which enamel covering by polyurethane was made is known (application-for-utility-model-registration Taira No. 56112 [ three to ] official report).

[0005] However, in the case of the aforementioned insulating-tape volume, since the activity to wind is unescapable, productivity is remarkably low and, for the reason, electric-wire cost is very high. Moreover, it will also be difficult to gather manufacture speed, since there is a property in which an appearance condition will get worse if the cost of resin is high although it has the advantage that thermal resistance is good since the insulating layer is formed by fluorine system resin in the case of the aforementioned fluororesin extrusion, and it pulls by the high shear rate further, and will become what has high electric-wire cost like an insulating-tape volume. Furthermore, in the case of this insulating

layer, since it is unremovable even if immersed in a solder bath, there is a problem that it exfoliates with an unreliable mechanical means, and the insulating layer of a terminal must be further soldered or sticking-by-pressure connected that top on the occasion of terminal processing performed when connecting insulated wire to a terminal.

[0006] Two or more extrusion insulating layers by the admixture which mixed the ionomer which used polyethylene terephthalate as base resin and, on the other hand, made the metal salt a part of carboxyl group of an ethylene-methacrylic acid copolymer at this are formed. Multilayer insulated wire which covered nylon as the maximum upper layer of an insulating layer is put in practical use. This Electric-wire cost (ingredient cost and productivity), soldering nature (carry out the direct continuation of insulated wire and the terminal), And coil workability (when winding insulated wire around a bobbin, both insulated wire is worn) a guide nozzle -- rubbing -- etc. -- what an insulating layer will be torn and the electrical property of a coil will be spoiled -- there is nothing -- it excels (a U.S. Pat. No. 5,606,152 specification, JP,6-223634,A). Furthermore, in order to raise thermal resistance, what changed polycyclohexane dimethylene terephthalate (PCT) into what is used as base resin from what uses the aforementioned polyethylene terephthalate as base resin is proposed. However, although these things pass E sorts of heatproofs in the test method with which thermal resistance was based on the schedule U of the 2.9.4.4th term of IEC950 specification (electric wire), and the schedule C of the 1.5.3rd term (transformer), it cannot respond to the rise of a demand level to thermal resistance in recent years, and becomes a rejection at B sorts of heatproofs.

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**EFFECT OF THE INVENTION**

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[Effect of the Invention] By the above explanation, multilayer insulated wire of this invention can be directly soldered at the time of terminal processing so that clearly, and moreover, heat-resistant level is also satisfied enough.

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[Translation done.]